

Patent Application of Derek B. Shuman  
for

**TITLE: CONVERTIBLE CLIPLESS BINDING/UNBOUND BICYCLE PEDAL**

**CROSS-REFERENCES TO RELATED APPLICATIONS**

Not applicable.

**BACKGROUND --FIELD OF INVENTION**

This invention relates to foot operated pedals for human powered machinery, more specifically to bicycle pedals, both clipless binding pedals where the shoe is attached to the pedal, and platform or cage type pedals, where the shoe is unattached to the pedal (unbound).

**BACKGROUND--PRIOR ART**

Bicycle pedals traditionally have supported the cyclist's feet on a platform which could either be an essentially large flat surface, or the edges of two transverse rails, more commonly known as cages. These pedals are most commonly used in what is called here an unbound mode, operation, or style, where the shoe is not attached to the pedal with any type of binding, clip, or strap. This allows the use of almost any type of shoe to be worn while riding the bicycle and requires a minimum of skill and encumbrance to operate the pedals. Many types of bicycle riding, including some types of racing, are also performed using unbound style pedals, where there is a significant chance the cyclist might fall off the bicycle, and/or where a high degree of handling skill and balance is required. Pedals for this type of riding have evolved to provide large shoe contacting areas and highly efficient sole gripping surfaces. In addition, the shoe contacting surfaces on some pedals are slightly curved to better fit the natural curvature of the front part of the sole, for better security from slipping and for more comfort. In certain types of riding, such as freestyle, or observed trials, the bottom side of the pedal, opposite the cyclist's foot is sometimes used to rest on a stationary object, such as a curb, log, rock, etc.

The platform pedal, especially the cage style pedal, has long been modified to provide an attachment of the cyclist's shoe to the pedal. The most common type of attachment prevalent today is still the toeclip and toestrap. The toeclip is a metal or plastic strip which extends forward from the pedal, under the toes, curving up in front of the toes, and then rearwards over the top of the cyclist's front portion of the foot. A flexible, adjustable loop, called a toestrap, connects the end of this toeclip with the body of the pedal and serves to bind the cyclist's foot to the pedal, a process generally known as "clipping in". This toeclip and toestrap shoe retention system allows the cyclist to pull the pedal rearward through the bottom of the stroke, pull it upward through the rearward part of the pedal stroke, and finally, to push it forward through the top of the stroke, all in addition to the usual downward pushing motion, which is the only propulsive stroke possible without the shoe retention system. This results in more power output and faster speeds. For more secure retention, the rails of the cage style pedal are utilized as part of a cleated shoe retention system for cyclists wearing stiff soled cycling shoes. A transverse grooved block, known as a cleat, is attached to the shoe sole, with the groove engaging the rearward cage rail. When used with a toestrap, this allows a higher force to be transmitted to the pedal through the top and bottom of the pedal stroke, and the groove aligns the shoe to the pedal, to maintain both fore/aft positioning and rotational alignment of the shoe to the

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pedal.

More recently, alternate means of attaching the sole of the shoe to the pedal have become popular, the generally termed clipless pedal, so named because of the lack of a toeclip and toestraps. This system comprises a binding on the pedal body that engages a binding plate attached to the shoe sole when the cyclist steps onto the pedal, similar to a step-in ski binding. This process is also generally referred to as "clipping in", and the binding plate is also generally referred to as a "cleat". All subsequent references to these two terms in this application pertain to clipless bindings, unless otherwise noted. After clipping in, the cyclist's foot stays attached to the pedal until a typically sideways twisting motion disengages the cleat from the binding. Several recent types of clipless binding systems for off-road bicycle usage have been designed which feature a small cleat fully recessed into the sole of the cycling shoe which then allows walking without contact of the cleat with the ground. This allows the rubber sole of the shoe to provide better traction on the ground, reducing slippage, and eliminates the marring of floor surfaces by the cleat, which is typically made from metal. These clipless shoe binding systems featuring recessed cleats have become very popular since their introduction around 1990, and though originally developed for off-road bicycle usage, they have also become popular for road cycling as well, as all cyclists wearing cleated cycling shoes must walk in them, even if only to get on and off the bicycle.

Advantages of the newer clipless binding systems, especially those with shoe recessed cleats, include the ability to have bindings on both sides of the pedal, unlike the older cage and toeclip system. This makes it easier for the cyclist to clip in to the bindings. The cyclist does not have to spin the pedal around to find the correct side. Other types of clipless pedals having only a single binding are counterweighted so that the correct side comes up automatically, however bearing friction, grease viscosity, and seal friction, all of which can be dependent on temperature, wear, adjustment, and the presence of dirt or water, tend to make this method of pedal alignment unreliable. If the pedal spins freely enough to assure that the counterweight reliably rotates the pedal, the cyclist often "overspins" the pedal inadvertently.

Both the traditional toeclip type pedal and all of the new clipless binding type pedals do not allow safe and comfortable unbound mode usage on both sides of the pedal while wearing a shoe with a cleat designed to engage the clipless binding(s). Nagano, U.S. Patent #5,003,841 (1991) shows a pedal with both shoe supporting surfaces (cages), and clipless bindings on both sides of the pedal. The binding cleats for use with this pedal are large and protrude substantially downward from the shoe sole, having the disadvantage of not being recessed into the sole of the shoe sufficiently to allow comfortable and safe walking or cycling in unbound mode. This pedal does, however, allow the bindings to be sufficiently recessed into the pedal, such that a shoe having a largely smooth or lightly treaded sole, and not having a cleat attached, may be used comfortably and safely in unbound mode.

The clipless pedals designed for shoe recessed cleats and having bindings on both sides of the pedal typically feature small shoe contacting areas that are slippery and not level or smooth. They are uncomfortable and unsafe to ride without wearing a stiff soled cycling shoe with a cleat that is clipped in to the binding. The toeclip pedal has only one toeclip on one side of the pedal, and thus the other side of the pedal can be ridden unbound style, however when this is done, the toeclip and toestraps hang underneath the pedal, close to the ground, and can be unsafe and prone to damage if the toeclip or toestraps snag or drag on the ground.

All of the clipless binding pedals, as well as the older toeclip style pedal have the inherent disadvantage of being difficult to mount and ride in many cycling situations. Clipping into these pedals requires concentration and accurate foot placement. On smooth roads at low uphill, level, or downhill grades, the cyclist can coast momentarily after an initial start and generally has enough time to perform this operation even though it is inconvenient and distracting. However, for medium to

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high uphill grades, or on difficult off road terrain, the cyclist must begin pedaling immediately after mounting the pedals. The cyclist typically clips into a pedal before mounting the bicycle, but then does not have time or balance to clip into the second pedal, or, if using a pedal with a single binding, to determine which side of the pedal is up, and to spin the pedal if necessary. Often the cyclist must fully come to a stop, straddle the bicycle and try to get clipped in from a standstill. This can be difficult even for an experienced racing cyclist and can result in time loss during a race. For a cyclist riding on busy streets, the distraction of trying to clip into the pedal can be dangerous by diverting the cyclist's attention to traffic, especially at intersections, where many hazards exist.

In many of the conditions where clipping into the pedals is difficult, riding while clipped in is also difficult and unsafe as well. This can include riding over rough terrain where agile body motions, including lifting a foot off a pedal, are required to keep balanced over the bicycle, or when riding in busy traffic, where the cyclist may feel the need to stop suddenly, to jump off the bicycle, or lift it suddenly onto a curb, in response to an impending hazard. The ability to perform agile body motions without the feet being attached to the pedals is the main reason why cyclists performing the sport of observed trials cycling (a form of obstacle course riding over difficult terrain), BMX (bicycle motocross racing) or freestyle (stunt riding at low speed on ramps and found urban objects) bicycle riding typically use unbound style pedals. This is true even though clipless binding pedals might appear to give the cyclist an advantage in hopping the bicycle over obstacles, as is often done in these sports. When encountering difficult terrain, the cyclist using clipless pedals cannot easily lift a foot off the pedal to maintain balance, and thus must often dismount the bicycle to walk it through, whereas they might be able to ride through it if they had unbound style pedals installed. Few cyclists, if any, carry an extra set of pedals and a wrench to change them, when they ride, as these items are heavy, and it is difficult and time consuming to perform this operation.

One manufacturer, Shimano, makes a pedal, model number M-323, which has a clipless binding on one side and a cage on the other side, the cage intended for unbound use only, and not for use with a toeclip and toestraps. This pedal has the advantage that the cyclist may comfortably ride the bicycle regardless of the type of shoe being worn. In addition, the cyclist wearing a shoe with a recessed cleat designed to engage the clipless binding, may ride in either unbound mode or clipped in mode. However, when mounting the pedal, either on the clipless binding side, or on the cage side, the cyclist must still look and/or feel for the side desired, and then spin the pedal one half turn, if necessary, to turn the desired side up. As with the aforementioned toeclip type and single sided clipless binding type pedals, this operation requires practice and concentration to perform smoothly and proficiently, and thus this pedal suffers many of the aforementioned disadvantages of both toeclip type and clipless binding type pedals. In most of the aforementioned situations where clipless and toeclip type pedals are difficult to mount and clip into, the operation of looking and/or feeling for which side is up, then spinning the pedal one half turn to place the cage side up is only marginally less difficult, due to the high probability of overspinning the pedal under the time pressure of mounting the bike and quickly clipping in. In addition, when riding in either mode, the cyclist must perform this operation every time he/she takes their foot off the pedal, as the pedal may spin to place the opposite, undesired side upwards. This problem is most pronounced when riding in unbound style, as the foot comes off the pedal easier, and more frequently. As such this pedal is at a disadvantage compared to conventional unbound type pedals for riding in difficult terrain or in conditions where the cyclist desires to ride in unbound mode while maintaining the ability to lift the foot off the pedal freely.

Nagano, U.S. Patent #5,806,379 (1998) shows a bicycle pedal system having both clipless bindings and unbound type tread surfaces. The preferred embodiment is essentially a clipless binding pedal supplied with separate platform type tread surfaces that attach to the binding using an integrally formed cleat on the underside of the platform surface. This is an obvious solution for

providing dual mode clipless or unbound capability on either one or both sides of the pedal. It is difficult to install and remove because the typical cleat engagement force of the binding is necessarily high, to prevent inadvertent cleat release from sideways foot pressure under the full weight of the rider. The tread surfaces must be installed by hand and thus great hand pressure is required to install and remove them, typically beyond the capability of most riders. A lever tool, such as a screwdriver must often be used to remove these platforms from the bindings. An alternative embodiment shows an unbound type pedal, similar to a platform or cage style pedal, that allows the attachment of clipless binding mechanisms, using screw fasteners. This alternative is also difficult to use, by the obvious requirement to separately carry a screwdriver. Both embodiments require the user to separately carry the platform surface or clipless binding attachments plus any tools needed to install them, a clear drawback. Both embodiments also require the user to stop riding in order to attach or detach the platform surface attachments, another clear drawback.

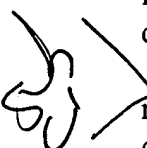
Chen, U.S. Patent #5,916,332 (1999) shows a cage type pedal having a detachable clipless binding for a recessed type cleat mounted on one side of the pedal. This pedal has the advantage of being convertible to unbound mode on both sides of the pedal by removing the clipless binding, which is attached to the pedal with a screw. This pedal, however, has the same disadvantages of the pedal system of Nagano, U.S. Patent #5,806,379 by requiring the rider to stop and dismount the bicycle in order change pedal operation modes, and by requiring the rider to carry either a screwdriver or hex wrench, and to carry the separate clipless binding when operating in unbound mode on both sides of the pedal.

What is needed is a clipless pedal for a recessed type cleat, that can be set or configured to operate as either a unbound pedal on both sides of the pedal, or as a clipless pedal on both sides of the pedal, so that the cyclist does not have to carry separate platform attachments, bindings, screwdrivers, hex wrenches, or other tools in order to change operation modes. Such a pedal would not require the cyclist to determine which side is up when mounting the pedals, and would allow him/her to simply step on the pedals (clipping in to the binding, if using clipless binding mode), and commence pedaling immediately. Furthermore, the mode of operation should be easily and quickly changeable without the need for the cyclist to stop, or even to look down at the pedals while coasting. Another benefit would be that the same set of pedals providing recessed cleat clipless operation would also allow comfortable cycling with any kind of shoe suitable for unbound operation, without the necessity of spinning the pedal to select the desired mode of pedal use. Such a convertible, truly dual mode pedal would eliminate the need to have more than one set of pedals, frequently installing and removing them from the crank arms, a process that eventually damages the pedal threads on the crankarm, or to carry separate platform surfaces or bindings.

There are some recent pedal designs which attempt to provide both unbound and clipless operation on both sides of the pedal, with only limited success. Hanamura, U.S. Patent #5,771,757 (1998) shows a pedal which incorporates clipless bindings on both sides of a pedal body having a large shoe contacting area, with similarities to a cage style pedal, surrounding both clipless bindings. The clipless bindings, however, protrude above the shoe contacting area of the cage at all times. This protrusion of the binding above the shoe supporting surface is necessary to properly engage the shoe cleat that is recessed into the shoe sole. This pedal is designed primarily for off-road downhill use, where the cyclist is usually clipped in, but becomes unexpectedly unclipped and cannot immediately clip back in due to travel at high speeds on rough terrain. Under these circumstances it is helpful to have cages surrounding the bindings to assist the cyclist in locating the pedal, providing a temporary place for the shoe to rest until the cyclist can get clipped back in. Limited propulsive pedaling may be possible without clipping back in, but the clipless binding which protrudes above the shoe supporting surface is slippery against the cleat when not properly engaged. The rider is forced to place his/her foot substantially askew in order to gain a secure foot placement. In addition, the

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bindings protruding above the shoe supporting surfaces are also slippery and uncomfortable against non cycling shoes without a cleat. Most non-cycling shoes have a relatively compliant sole and the foot feels a concentrated pressure under the small clipless binding. Thus, this pedal does not allow comfortable, safe, or efficient pedaling with any shoe which is not clipped in to the binding; as such, it is not suitable for unbound style riding, except under the temporary and specific conditions it was designed for.



Ueda, U.S. Patent # 5,784,931 (1998) shows a clipless bicycle pedal designed to engage a recessed cleat, having a spring loaded, rotatable tread cage surrounding the clipless binding. This design is a variation of the previous design of Hanamura, U.S. Patent #5,771,757, in attempting to provide contact between the tread cage and the shoe sole while the cleat is engaged with the binding mechanism. It is described, though not claimed, as providing a shoe resting surface for a cycling shoe when the cleat cannot be engaged, as encountered during many types of off-road bicycle racing. However, the cage is only designed to rotate about the pedal axis to move out of the way to allow cleat engagement. It's height relative to the binding does not change. No figure shows a shoe sole being supported by the cage alone. Under any significant foot pressure, the cage will rotate relative to the binding until the shoe is supported either on top of, or engaged with the binding. Only a cleat engaged position will be stable, as metal to metal contact between the bottom of the cleat and the top of the binding is very slippery and insecure. As such, the cage is not truly supportive of the rider's foot and cannot provide a stable shoe supporting surface for any type of shoe. As such this pedal cannot be considered a dual mode unbound/clipless pedal; it is a clipless pedal that attempts to provide a temporary surface for the rider to place their foot when terrain and/or speed prevent them from immediately clipping in to the binding. Thus this pedal design is not effective for use in unbound mode, and, like the design of Nagano, U.S. Patent #5,771,757 described above, is intended only to aid the rider in achieving cleat engagement under difficult circumstances. As such, it does not anticipate a bicycle pedal according to this invention, as it does not provide sufficient height variability between a binding and a shoe supporting surface to be comfortably and safely usable in either clipless or unbound mode.

Other pedal designs show height variability between a clipless binding and the pedal body, though not for the purpose of providing both unbound and clipless modes on a single pedal. Ueda, U.S. Patent #6,012,356 (2000) shows a clipless bicycle pedal designed for a flush or recessed shoe cleat having a small amount of height variability between the binding and the pedal body, for the purpose of achieving a slight amount of contact between the portion of the shoe sole laterally surrounding the cleat and the pedal body. This lateral shoe sole contact is claimed to reduce side to side rocking of the shoe when engaged with the cleat. This pedal is designed for clipless operation only, and the pedal body is formed to directly support the shoe sole only at two small areas over the pedal spindle; it does not provide unbound style support over a large shoe sole area. The small amount of height variability acts only on part of the binding and would not be sufficient to fully retract the binding into an platform or cage style pedal body to allow it to be used in an unbound mode.

A desirable modification to the aforementioned desired dual mode clipless/unbound pedal having a choice of either clipless or unbound operation on both pedal sides, which would be useful for riding in steep or difficult terrain, or for riding in busy traffic, would be for the cyclist to be able to preset the pedal to automatically transform to an unbound type pedal on both sides of the pedal, immediately upon the release of the cleat from the binding. This would allow a cyclist wearing cycling shoes with recessed clipless binding cleats to deliberately unclip from the pedal and continue pedaling, uninterrupted, in unbound mode over sections of difficult terrain, or in busy traffic for instance, without having to first unclip, and then reach down to convert the pedal to unbound mode. The conversion operation could be difficult or impossible to perform while coasting the bicycle in

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these conditions, requiring the rider to stop to make the conversion. This automatic conversion feature thus allows a cyclist to remain riding clipped in, as long as possible, as it eliminates the necessity of predetermining or guessing where the terrain or riding conditions become too difficult to continue riding while being clipped in. Thus, a cyclist could ride while staying clipped in into more difficult terrain than otherwise possible, as the rider would not have to stop to switch the pedals to unbound mode. This would be a decided advantage in off road competitive riding on difficult terrain.

Another useful pedal design for certain types of riding such as observed trials or freestyle, would be a pedal which features a fixed height shoe supporting surface on one side, in combination with a clipless binding and shoe supporting surface on the other side, where the relative height between the binding and shoe supporting surface (on the same side) are sufficiently variable to allow the pedal to be used as an unbound style pedal on both sides, or as an unbound pedal on one side, and a clipless pedal on the other side. This would allow the cyclist to use the downward facing surface to momentarily rest or balance on a log, rock, curb, or other suitable object, as is done in above mentioned sports, while remaining clipped in. The downward facing shoe supporting surface would provide better grip on objects, and be less susceptible to damage than an exposed binding facing downwards. A desirable modification of this design would be to additionally be able to set the pedal to automatically transform to an unbound type pedal on both sides of the pedal, immediately upon the release of the cleat from the binding, as described in the preceding paragraph. Thus, the cyclist can ensure that a shoe supporting surface always faces downward, even after unclipping from the pedal.

### SUMMARY

Accordingly, a bicycle pedal according to this invention provides:

~~A bicycle pedal having both clipless shoe retention mechanisms (bindings) and full load bearing shoe supporting surfaces on each opposing side of the pedal, wherein the relative height between the clipless binding and the shoe supporting surface of each side of the pedal is sufficiently variable, such that the cyclist's shoe either rests and is supported fully on either of the shoe supporting surfaces to provide unbound operation, without the riders shoe being attached to the pedal, or engages either of the bindings to provide clipless binding operation, as desired. The setting of the relative height between the bindings and shoe supporting surfaces is effected on both sides of the pedal, simultaneously, upon a single actuation performed by the cyclist. The setting of the relative height between the bindings and shoe supporting surfaces can be quickly and easily accomplished by the cyclist, without looking down, even while riding (coasting). The cyclist may also set the pedal, while engaged to the binding, to automatically change to unbound mode, on both sides of the pedal simultaneously, immediately upon the release of the shoe cleat from the binding. In a further embodiment, only one side of the pedal features a clipless binding and a shoe supporting surface which are relatively variable in height; the other side of the pedal features a fixed shoe supporting surface only. The aforementioned feature providing automatic change to unbound mode upon shoe release may be combined with this embodiment.~~

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## OBJECTS AND ADVANTAGES

Several objects and advantages of the present invention are:

(a) Cyclists retain all the existing advantages of dual sided unbound type pedals, more specifically: cyclists wearing either cycling shoes with recessed clipless cleats, or other suitable shoes not specifically designed for cycling, such as normal street or athletic shoes, can safely and comfortably mount the pedals and ride in an unbound mode without first having to check which side of the pedal is up, and without having to spin the pedal one half turn, if required. This results in less distraction of the cyclist from cycling, allowing safer cycling in difficult terrain or busy environments. The rider is able to pedal over more difficult terrain than is possible when using clipless bindings. This can produce a competitive advantage in many types of off-road bicycle racing, and greatly eases the resumption of uphill cycling from a stop, either on or off-road. The cyclist need not stop to attach separate shoe supporting surfaces to the bindings, or to change pedals in order to have this capability.

(b) The cyclist additionally retains all the existing advantages of dual sided clipless pedals, more specifically: the cyclist, if wearing shoes with clipless cleats, can also mount the bicycle and clip in to bindings on either side of the pedal, without the need to check which side of the pedal is up, and to spin the pedal one half turn, if required, to place a binding upward. The cyclist need not stop to attach separate bindings to an unbound type pedal, such as a platform or cage style pedal, or to remove such pedals from the crankarms, and then install clipless pedals to have this capability.

(c) The cyclist can switch the mode of pedal operation from unbound mode to clipless binding mode or vice versa, quickly and easily, even while riding, without looking down at the pedal. The mode of operation changes on both sides of the pedal simultaneously, upon a single actuation from the cyclist.

(d) By providing an optional setting to provide automatic conversion to unbound mode upon cleat release, the cyclist can ride, if desired, with increased confidence, while clipped in to the binding, through most riding situations which would otherwise be safer to ride through in unbound mode, as the cyclist can immediately change the pedal to unbound mode, by simply releasing [his/her shoes] from the binding. This allows the cyclist to output more energy over rough or difficult terrain, which can provide a competitive advantage in many types of off-road bicycle racing. It can save the cyclist from having to dismount and walk the bicycle through difficult terrain, as this is often the only option for cyclists who ride clipless pedals that do not have a platform or cage type unbound shoe supporting surface on one side of the pedal.

(e) In an optional embodiment providing a fixed shoe supporting surface only on one side of the pedal, and having the aforementioned relative height variability between a clipless binding and a shoe supporting surface on the other side, and in addition, having the automatic conversion feature described in paragraph (d) above, a cyclist may ride through rough terrain while clipped in, and may use the bottom shoe supporting surface facing downward to securely rest momentarily on obstacles such as logs, rocks, or other suitable objects, while maintaining the advantage of having the pedal immediately convert to unbound mode on the top side of the pedal, should the cyclist need to unclip for safety or balance reasons, in situations where the cyclist cannot easily clip back into the pedal. This embodiment can be operated without utilizing the automatic conversion feature of paragraph (d) above, and the cyclist still has the advantage of a pedal which can function in both clipless and unbound modes, as previous designs allowed, yet retains the additional capability of operating the same pedal in unbound mode on both sides simultaneously, without requiring the cyclist to look or

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feel for which side of the pedal is up, and to spin it one half turn, if necessary, when operating in this mode, or to stop and attach separate shoe supporting surfaces. This is advantageous for cyclists who desire to ride in unbound style only in certain conditions, such as rough ground, or busy traffic, that make spinning the pedal one half turn difficult and/or unsafe. Some cyclists may not care to have clipless binding capability on both sides of the pedal, as they would choose this mode of operation only under conditions where there is ample time to spin the pedal to place the binding side of the pedal upward. These riders would still prefer to have the unbound mode available on both sides of the pedal, of course. Such a pedal will be lighter and less expensive due to the elimination of one of the bindings.

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## LIST OF FIGURES- PREFERRED EMBODIMENT

Figure 1A is an oblique view of the preferred embodiment of a bicycle pedal according to this invention showing bindings extended outward from the pedal body for use as a clipless binding pedal.

Figure 1B is an oblique view of the preferred embodiment of a bicycle pedal according to this invention showing bindings retracted into the pedal body, for use as an unbound style pedal.

Figure 2 is an oblique view of the preferred embodiment of a bicycle pedal according to this invention, with a partial section and cutaway showing internal details, with clipless bindings extended.

Figure 3A is a sectional side view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 3A-3A on figures 1A and 2, with the clipless bindings extended.

Figure 3B is a sectional side view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 3B-3B in figure 1B, with the clipless bindings retracted.

Figure 3C is a sectional side view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 3A-3A in figure 1B and figure 2, but with the clipless bindings engaged.

Figure 3D is a side view of the preferred embodiment of a bicycle pedal according to this invention, with bindings extended outward from pedal body, as viewed in the same direction as section lines 3A-3A, in figures 1A and 2.

Figure 4A is a sectional side view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 4A-4A in figures 1A and 2.

Figure 4B is a sectional side view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 4B-4B in figure 1B.

Figure 5A is a sectional top view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 5-5A in figures 3A, 3D, and 4A.

Figure 5B is a sectional top view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 5-5B in figures 3A, 3D, and 4A.

Figure 5C is a sectional top view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 5C-5C in figure 4B.

Figure 6A is a sectional top view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 6A-6A in figure 3C, showing the bindings in a pre-retracted mode of operation.

Figure 6B is a sectional top view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 5-5B in figures 3A, 3D, and 4A, showing the bindings being fully released for retraction, but prior to actual retraction.

Figure 7 is a sectional end view of the preferred embodiment of a bicycle pedal according to this invention, as indicated by section lines 7-7 in figures 1A, 2, 5A, and 5B.

Figure 8 is sectional side view of an alternative embodiment of a bicycle pedal according to this invention, as indicated by section lines 3A-3A on figure 1A, closely related to the preferred embodiment, but featuring a single variable height binding on one side of the pedal only.

Figure 9 is a side view, with a partial section as indicated in figure 10, of a prior art shoe and cleat system.

Figure 10 is a bottom view, as indicated by view arrows in figure 9, of a prior art shoe and cleat system.

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## LIST OF FIGURES -ALTERNATE EMBODIMENT

Figure 11A is an oblique view of an alternative embodiment of a bicycle pedal according to this invention showing shoe-supporting surfaces in a retracted position, for operation in clipless binding mode.

Figure 11B is an oblique view of an alternative embodiment of a bicycle pedal according to this invention showing shoe-supporting surfaces in an extended position, for operation in unbound mode.

Figure 12A is a side view of an alternative embodiment of a bicycle pedal according to this invention showing shoe-supporting surfaces in a retracted position, for operation in clipless binding mode.

Figure 12B is a side view of an alternative embodiment of a bicycle pedal according to this invention showing shoe-supporting surfaces in an extended position, for operation in unbound mode.

Figure 12C is a side view of an alternative embodiment of a bicycle pedal according to this invention with shoe-supporting surfaces in an extended position, showing a method for retracting shoe supporting surfaces for conversion to operation in clipless binding mode.

Figure 12D is a sectional side view of an alternative embodiment of a bicycle pedal according to this invention showing internal details of a cleat engaging binding, for operation in clipless binding mode.

Figure 13A is an top view, with partial sections showing internal details of an alternative embodiment of a bicycle pedal according to this invention with shoe-supporting surfaces in a retracted position, for operation in clipless binding mode.

Figure 13B is an top view, with partial sections showing internal details of an alternative embodiment of a bicycle pedal according to this invention with shoe-supporting surfaces in an extended position, for operation in unbound mode.

Figure 14 is an end view, with a half section showing internal details of an alternative embodiment of a bicycle pedal according to this invention.

FIG. 11A

**LIST OF REFERENCE NUMERALS  
PREFERED EMBODIMENT**

11 threads	12 spindle	13 wrench flat
14 pedal body	15 shoe supporting surface	16 sealed roller bearing
18 ball bearing assembly	19 roller bearing journal	20A, 20B outer ball race
21 ball	22 groove	23 shaft seal
24 retainer cap	25 screwdriver slot	27 shoe
28 sole	29 recessed sole portion	30 cutout
31 cleat	32 binding	33F, 33R tab
34 base	35 bail	36 cutout
37 hole	38F, 38R pin	39 push tab
40 lock spring	41 lock tab	42 link
43 linkage	44 axle	45 retraction spring
46 clip	47 protrusion	48 pin
48B bore	49 protrusion	50 clip
51 bevel	52 clip spring	53 tab
54 spring lever	55 end	56 hinge loop
57 end	58A, 58B release plate	59 cleat engagement notch
60 hinge loop	61A, 61B bail spring	62 pin
63 block	64A, 64B hinge loops	65 screw
67 cleat engagement guide	66 pin	68 pushrod
69 cleat ejector ramp	70 conical end	71 bore
72 pocket	73 mounting hole	74 stop button
76 central tube	78 central bore	80 stop ledge
81 upper ledge	82 lower ledge	83, 84', 84" aperture
86 rib	87 pin boss	88F front cleat tip
88R rear cleat tip	89 aperture	91 rivet
92 flush rivet	94 end rib	95L, 95R clip pocket
96 assembly hole	97 conical depression	98 thumb or forefinger
99 opposing finger (to 98)		

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# **LIST OF REFERENCE NUMERALS ALTERNATE EMBODIMENT**

110 linkage	111 threads	112 spindle
113 wrench flat	114 pedal body	115 shoe supporting surface
115F, 115R front, rear shoe supporting surface section	116 sealed roller bearing	118 ball bearing assembly
117L, 117R left, right side arm	120A, 120B outer ball race	121 ball
119 roller bearing journal	124 retainer cap	125 hex wrench socket
122 groove	132 binding	134 base
130 slot recess	136L, 136R left, right bail pivot tab	
135 bail	137' bail pivot pin bore	137" bail pivot pin bore
137' bail pivot pin bore	138 bail pivot pin	
139L, 139R left, right bail spring	140 bail spring block	
141 adjustment screw	142 front rail	143 rear rail
144L, 144R left, right front rail connector plate		
145L, 145R left, right front rail cage pivot bore		
146L, 146R left, right rear rail connector plate		
147L, 147R left, right rear rail cage pivot bore		148 front rail cage assembly
149 rear rail cage assembly	150 pivot journal	152 pivot tube
154 pivot journal	156 rail extension spring	157A, 157B spring end
158 limit pin	159 limit pin bore	160 limit slot
160' semicircular end	160'' semicircular end	162 limit slot
162' semicircular end	162''' semicircular end	164 spring end slot
165 spring end bore	166 spring end bore	
167L, 167R left, right extension lock pin bore		
168L, 168R left, right extension lock pin		169 shoulder
170 spring	172L, 172R left, right extension lock pin housing	
174 housing lock pin bore	175L, 175R left, right semicircular surface	
176 retraction lock pin housing		177 retraction lock pin bore
178 retraction lock pin bore	179 rail mount tab	181 threaded hole
182 retraction lock pin	183 shoulder	184 spring
185 threaded hole	186 central bore	187 rail screw
188 housing screw	190 cleat engagement guide	191 cleat ejector ramp
192 cleat engagement notch	195 screw	

TOTAL: 08581660

## DESCRIPTION OF INVENTION

A preferred embodiment of the convertible pedal is shown in figures 1 through 7. A pedal for the left side of the bicycle is shown in all figures. Figure 2 provides a general view of most parts and features. A pedal spindle 12, preferably formed of high strength steel or titanium alloy, features threads 11 for attachment to a bicycle crank arm (not shown), and wrench flats 13 for tightening to crank arm. Pedal body 14 is preferably formed of extruded or cast aluminum alloy, or other lightweight metal or high strength plastic. All subsequently described parts, unless otherwise noted, are preferably formed of high strength metal such as alloy steel or titanium. Figure 3D shows the full extrusion cross section profile with hidden lines. Pedal body 14 features top and bottom shoe supporting surfaces 15, optionally textured as shown here, to provide good shoe sole 28 traction (fig. 4B). Top and bottom shoe supporting surfaces 15 are formed integral with central tube 76, ribs 86, and end ribs 94; these features creating apertures 83, 84', 84'', and 89. Ribs 86 feature pin bosses 87, and central tube 76 features central bore 78 (figs. 5A, 7), machined with threads and multiple steps (not labeled). Central cutout 30, and pocket 72 are formed, such as by machining, into each section of extrusion forming pedal body 14 to provide operating space and protection for bindings 32, and most of the subsequently described parts of this invention. Cutout 30 is a generally rectangular shaped opening as viewed from the top in figs. 5A-5D, 6A, and 6B. Clip pockets 95L and 95R are rectangularly shaped extensions of cutout 30. Pedal body 14 also features stop ledges 80, and upper and lower ledges 81 and 82, respectively.

Spindle 12 is rotatably connected to central bore 78 by sealed roller bearing 16, and ball bearing assembly 18 (figs. 5A, 7). Roller bearing 16 rides on journal 19. Ball bearing assembly 18 comprises two angular contact outer ball races 20A and 20B, and balls 21, which ride in groove 22 in pedal spindle 12. Retainer cap 24 threads into central bore 78 of pedal body 14 to tighten against and fixedly retain outer ball races 20A and 20B. Spindle seal 23, formed of elastomer, is fixedly mounted in pedal body 14 and rotatably seals against spindle 12. Sealed roller bearing 16 features integral shaft seals (not labeled) on both sides of the cylindrical rolling elements. Each binding 32 is an assembly and moves as a unit, and consists of base 34, bail 35, pins 38F and 38R, springs 61L and 61R, block 63, screw 65, and lock spring 40. Each base 34 features pairs of tabs 33F and 33R. Each pair of tabs 33F and 33R fixedly support pins 38F and 38R, respectively. Axle 38R rotatably supports bail 35. Each bail 35 is urged forwards against the rear of base 34 by bail springs 61L and 61R. Urging force of each pair of bail springs 61L and 61R is adjustable by screw 65, threaded into block 63, and bearing against conical depression 97 of base 34 (fig. 3A). Each bail 35 features cutout 36. Both base 34 and bail 35 feature cleat engaging notches 59. Base 34 features cleat engagement guides 67, and cleat ejector ramps 69. Base 34 features hole 37 through which push tab 39 of lock spring 40 protrudes. Lock spring 40 is fixedly mounted to base 34 with rivets 92, whose heads are flush with the top surface of base 34. Lock tabs 41 are formed on the transverse ends of lock spring 40. Pins 38F and 38R are fixedly mounted in, and protrude laterally outward from tabs 33F and 33R respectively, of each base 34, each protruding end being rotatably supported by link 42. Both axles 44 are fixedly supported on each end in pin bosses 87 of pedal body 14. Retraction springs 45 are mounted on axles 44, with one end bearing against link 42, and the other end bearing against central tube 76. Bail springs 61R prevent excessive axial movement of retraction spring 45, as can be seen in figures 3A and 3B, keeping retraction spring 45 ends engaged with link 42 and central tube 76. Two clips 46 are rotatably supported in pedal body 14 by pins 48, which are fixedly mounted in bores 48B of pedal body 14 (figs 1A, 1B). Similarly, two clips 50 are rotatably supported on pins 48,

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also fixedly supported in bores 48B of pedal body 14. Clips 46 and 50 are axially restrained on pins 48 by ledges 81 and 82. Clips 46 and 50 each feature protrusions 47 and 49, bevel 51, and tab 53. Clip 46 features end 55 and clip 50 features end 57. Springs 52 are fixedly mounted to clips 46 and 50 by rivets 91. Spring levers 54 are fixedly mounted to clips 46 by rivets 91, and feature hinge loops 56 on their ends. Release plates 58A and 58B feature hinge loops 60 on their ends which are rotatably connected to hinge loops 56 with pins 62. Pins 62 are fixedly mounted in hinge loops 60, and rotatably mounted in hinge loops 56. Both release plates 58A and 58B feature coaxial hinge loops 64A and 64B which are rotatably connected together with pin 66. Pin 66 is fixedly mounted in hinge loops 64A and 64B of release plate 58A and rotatably mounted in hinge loops 64A and 64B of release plate 58B. Pushrod 68 is slidably supported in bore 71 (figs 6A,6B) of pedal body 14, and features a conical end 70. Stop buttons 74 are fixedly mounted in mounting holes 73 in pedal body 14.

Assembly of the preferred embodiment is accomplished by first assembling each clip 46, to its associated spring 52, spring lever 54, and release plate 58A or 58B together with pins 60 and rivets 91. Each of these subassemblies is then inserted into cutout 30, feeding release plates 58A or 58B through apertures 89 formed by shoe supporting surfaces 15, pin bosses 87, ribs 86 and end ribs 94. Clips 46 are then placed in clip pockets 95L and affixed to pedal body 14 by pressing pin 48 into its respective bore 48B. Clips 50 are assembled to their respective springs 52 with rivets 91 and assembled to pedal body 14 with pins 48 in a similar manner. Next, bindings 32 are assembled to links 42 on pins 38F and 38R and inserted into cutout 30 while holding clips 46 and 50 apart, as in fig 6B. Links 42 are then affixed by insertion of axles 44 through pin bosses 87. Springs 45 are placed on axles 44 during the insertion of axles 44. Roller bearing 16 and ball race 20A are then assembled to central bore 78. Spindle 12 is then assembled to pedal body 14 by inserting it through roller bearing 16, and inner ball race 20A, far enough past its normal assembled position in order to fully expose groove 22. Journal 19 is made sufficiently long enough to avoid interference of the adjacent conical section of spindle 12 with the shaft seal of roller bearing 16 during this operation. Balls 21 are then assembled to groove 22 with grease, then the spindle is withdrawn to seat the balls into race 20A. Race 20B is then assembled and secured with threaded retainer cap 24. Release plates 58A and 58B are then assembled together by inserting pin 66 through assembly hole 96 (fig 5A), and pressing it into hinge loops 64A and 64B.

In operation of the preferred embodiment, pedal body 14 provides textured shoe supporting surfaces 15 on both the upper and lower sides of the pedal for gripping and supporting, under full rider's weight, the sole 28 of either a non-cycling shoe, or a cycling shoe 27 with a cleat, 31 mounted on a recessed sole portion 29 (figs 9,10). Shoe supporting surfaces 15 may be textured, an example of which is shown, or otherwise configured to provide a shoe gripping surface without cleat attachment. Needle roller bearings 16 with integral seals are used to provide high radial load capability on a relatively large shaft diameter section, and pedal spindle 12, may be appropriately hardened at journal 19, for use as the inner bearing race. Ball bearing assembly 18 carries both radial and axial loads and serves to rotatably affix pedal body 14 to spindle 12. Groove 22 may also be appropriately hardened.

Central cutout 30 encompasses bindings 32 and links 42 when they are retracted into pedal body 14. The cleat engagement features of the bindings shown here are similar to existing bindings, and do not constitute the essence of this invention. They are described here for clarity, and to show compatibility with the invention. They are representative of a family of clipless bindings which can be used; these mechanisms typically engaging a small cleat attached to the shoe and typically, but not always, recessed into the shoe sole. Cleat 31 is mounted to a recessed sole portion 29, of sole 28, of shoe 27. Cleat 31 has a front tip 88F, and a rear tip 88R, both of which are beveled on their bottom

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surfaces, flat on their top surfaces, and which engage notches **59F** and **59R**, respectively (fig.3C). Engagement is typically performed by inserting tip **88F** into notch **59F** first, then stepping downward into binding **32** so that the beveled bottom surface of tip **88R** moves bail **35** rearward against the action of bail springs **61L** and **61R**. Cleat engagement guides **67** help direct front cleat tip **88F** into cleat engaging notch **59F**, and the flat upper surface of front cleat tip **88F** is restrained from upward movement by the bottom surface of notch **59F**. Once the extreme end of cleat tip **88R** passes notch **59R**, bail **35** moves forward and retains cleat **31** in notch **59R** by contact with the flat upper surface of rear cleat tip **88R**. The bottom surface of cleat **31** is now resting on the top surface of base **34**, as shown in figure 3C. To release cleat **31**, the rider twists their foot sideways, rotating cleat **31** in binding **32** about a vertical axis. The action of tip **88R** against beveled notch **59R** causes bail **35** to move rearward, allowing cleat **31** to rotate to a position where it contacts cleat ejector ramp **69**, forcing cleat **31** upward and free from binding **32**. Other types of recessed cleats and bindings exist and could easily be substituted for the bindings shown, as they are of similar size and shape. Bindings **32** extend far enough above the top surface of shoe supporting surface **15** to allow cleat engagement, rotation and release without shoe sole **28** making contact with shoe supporting surface **15**.

One or both bases **34** rotatably connect the ends of links **42**, to form a parallelogram type linkage. This forces links **42** to undergo simultaneous rotation when pivoting on axles **44**. This results in both bindings **32** either extending out of cutout **30** of pedal body **14**, or retracting into it simultaneously, when links **42** pivot counter-clockwise or clockwise, respectively, on axles **44**, as viewed in figs 3A, and 3B respectively. The retracted position of each binding **32** is determined by stop ledge **80**, which contacts the bottom edge of bail **35**, as shown in figure 3B, preventing any further retraction of bindings **32** into cutout **30** of pedal body **14**. When fully retracted, the top exposed surfaces of bindings **32** are sufficiently flush, or below the top surface of shoe supporting surface **15** to assure that full and secure contact of sole **28** is made with shoe supporting surface **15**, without contact of recessed cleat **31**, on any part of the pedal (fig. 4B).

Extension of bindings **32** from the retracted position of figures 1B, 3B, and 4B are performed by placing thumb or forefinger **98** into cutout **36** on bail **35**, and an opposing finger or thumb **99** on the top forward edge of pedal body **14**, as shown in figure 3B, then squeezing finger and thumb together while simultaneously pulling upwards to extend bindings **32** to their extended position, as shown in figure 3A. This is a motion that can be performed while astride the bicycle, if desired, without the rider needing to look down at the pedal, at these features are large and easy to recognize by feel, and the motion is simple. In the fully retracted position of figure 3B, angle,  $\phi$ , formed between a line through both link **42** rotation pivot axes at axles **44** and a line through one link **42** rotation pivot axis at axle **44** and a pivot axis at either pin **38F** or **38R** on the same link **42** is no less than 10 degrees. This prevents the parallelogram linkage from collapsing into an unstable state where all pivot axes at axles **44**, **38F**, and **38R** lie in a single plane, which could prevent the extension of both bindings **32** by the aforementioned action of squeezing thumb **98** and finger **99** against bail **35** and pedal body **14**, respectively.

Force for retraction motion of bindings **32** is provided by retraction springs **45**, located coaxially on axles **44**. One end of spring **45** bears against link **42**, and the other against central tube **76**, thus urging link **42** to rotate towards the retracted binding position. Bindings **32** are held in the extended position of figs. 1A, 2 and 3A by protrusions **47** and **49** on both clips **46** and **50**, which rotate inward towards bindings **32** under the action of clip springs **52**, to capture and restrain links **42** against rotation, as shown in figs 2 and 5A.

When extending bindings **32**, from the retracted position, as shown in figs. 1B and 4B, the front edge of link **42** slides against bevel **51**, serving to pivot clips **46** and **50** laterally outward away from

bindings 32, as shown in fig. 6B. Bevel 51 is best viewed in figure 7. In the outwardly pivoted position of clips 46 and 50, protrusions 47 extend inward toward bindings 32 slightly more than protrusions 49, providing a positive motion stop for links 42 upon full extension of bindings 32. Lock tab 41 is beveled on its underside to avoid interference with outwardly rotated ends 53 of clips 46 and 50, as bindings 32 approach their fully extended position. Once motion of links 42 are stopped in the binding extended position (fig. 6B), clips 46 and 50 pivot about pins 48 inward toward the binding under the actions of clip springs 52 to firmly lock links 42 into the binding extended position shown in figures 1A, 2, 3A, 4A and 6A. With the cleats 31 engaged, the rider may, in addition to the usual downward pushing force, also push forward and/or pull rearward at top and bottom parts of the pedal stroke, respectively, and this force is transmitted to the pedal body by clips 46 and 50 through pins 48 to transfer additional motive energy to the bicycle. Furthermore, these forward and rearward pedaling forces are transferred into pedal body 14 by all 4 clips (46 and 50) and pins 48, even though only one binding 32 is engaged. This reduces stress and deflection on these and other components.

To retract bindings 32 for unbound operation, the cyclist pushes inward with forefinger or middle finger 98 on release plates 58A and/or 58B, near or on the hinge joint of pin 62 and hinge loops 64A and 64B connecting them together (fig. 6B). These plates are large and easy to find by feel, without the rider needing to look down to find them. The motion is, like the aforementioned binding extension operation, easily accomplished while astride the bicycle, without the need to look down at the pedal. In the usual case where the cyclist's shoe cleat 31 is not engaged with binding 32, the toggle-like spreading action of release plates 58A and 58B, as they are depressed, serve to push both hinge loops 56 on spring levers 54 apart from each other, causing clips 46 to pivot away from the binding, thereby releasing both links 42 which are held by clips 46. Simultaneously, each end 55 of clip 46 pushes against end 57 of clip 50 during this pivoting motion, causing clips 50 to pivot away from both links 42 which they are engaged with, as shown in figure 6B. Both bindings 32 are then free to retract into cutout 30 of pedal body 14, under the actions of retraction springs 45. The stiffness of spring lever 54 is made sufficiently higher than the stiffness of clip springs 52 to assure sufficient rotation of clips 46 and 50 under these conditions. Should any unbalanced forces be present between bindings 32 and their associated clips and spring levers, such as from presence of dirt, or a forward or rearward force component applied to release plates 58A and/or 58B, stop buttons 74 provide a centering force to maintain symmetric and equal pivoting action of all clips 46 and 50 at their maximum outwardly pivoted angle, as shown in figure 6B. This ensures that both bindings 32 are released for retraction simultaneously. Release of links 42, and thus retraction of bindings 32, will occur just before release plates 58A and 58B reach their fully spread position, however provision for these release plates to reach and extend past their fully spread position is provided for an alternate mode of operation described in the next paragraph below. If this overextension occurs, as shown in fig. 6A where angle  $\theta'$  is less than 180 degrees, under either mode of operation, pushrod 68, slidably located in bore 71 of pedal body 14 provides for return of release plates 58A and 58B to a less than fully spread position by moving laterally outward to contact release plate 58A, as indicated in figure 6B by angle  $\theta$  exceeding 180 degrees. This occurs when the front edge of link 42 slides against conical end 70 of pushrod 68, pushing it outwards when almost fully pivoted to the position for full binding 32 retraction shown in figures 4B, and 5C. Once release plates 58A and 58B reach a less than fully spread position, clip springs 52 move them back to their normal resting position through clips 46 and 50, and spring lever 54. The bulged center section of link 42 occludes a small part of conical end 70 throughout the range of motion of link 42, thus allowing only the majority of conical end 70 to extend into cutout 30. The cylindrical section of pushrod 68 is kept within bore 71 to avoid contact with the edge of links 42, which would prevent

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their rotation. Release plate **58A** prevents pushrod **68** from falling out of bore **71**.

Though the motion of bindings **32** relative to shoe supporting surfaces **15** is arcuate, it is the height of the top surfaces of each binding **32** relative to the height of the corresponding shoe supporting surface **15** which determines whether the pedal can be used in either a clipless binding mode, with a cycling shoe **27** having a sole **28** recessed cleat **31** contacting and engaging only a clipless binding **32**, or in an unbound mode where a cycling shoe **27**, or other shoe contacts only a shoe supporting surface and is otherwise unattached to the pedal. This relative height can be generally defined as the difference in height of a plane parallel to the rotation axis of pedal spindle and tangent to shoe supporting surface **15**, at the point of shoe sole **28** contact, and the height of a plane similarly parallel to pedal spindle **12** rotation axis and tangent to the uppermost facing surfaces of a binding **32** at a similar point of shoe **27** or cleat **31** contact. Thusly, pedal body **14**, pins **38F** and **38R**, links **42**, pins **44**, springs **45**, clips **46** and **50**, pins **48**, springs **54**, release plates **58A** and **58B**, pins **60** and **62**, comprise the primary parts of a rider actuated linkage **43** (fig.3A) that stably supports and connects bindings **32** to shoe supporting surfaces **15** in a relative variable height configuration.

Figure 3C and 6A show operation of a "pre-retract" mode of operation whereby the pedal can be set in advance to automatically retract bindings **32** into cutout **30** immediately upon release of cleat **31** from binding **32**. When cleat **31** is engaged with binding **32**, upper lockspring **40** is deflected downward, placing lock tabs **41** into the space between tabs **53** and cutout **30**. This blocks the pivoting action of upper clips **46** and **50** thus preventing retraction of bindings **32**. The cyclist still depresses release plates **58A** and/or **58B** in the manner previously described, and this action will cause spring levers **54** to bend into an arcuate shape, as shown in figure 6A. When release plates **58A** and **58B** are fully depressed, they extend through their maximally spread position until hinge loops **64A** and **64B** contact pedal body **14** at the base of pocket **72**, shown as  $\theta'$  in fig. 6A. They are held in this overextended position, which is slightly but sufficiently stable, under the force of spring levers **54** until the cyclist disengages cleat **31** from binding **32**. Cleat **31** disengagement allows lock spring **40** to unbend, moving lock spring ends **41** upward and out of the space between tabs **53** and cutout **30**. This frees clips **46** and **50** to pivot fully outward away from bindings **32**, under the action of spring levers **54**, as shown in figure 6B. Bindings **32** are then free to retract into cutout **30** under the action of retraction springs **45**, as described previously. Similarly as before, when bindings **32** approach their fully retracted position, outer front edge of link **42** slides against conical end **70** of pushrod **68**, thus urging pushrod **70** outward, against release plate **58A**. This outward movement of pushrod **68** is sufficient to articulate release plates **58A** and **58B** out of their overextended position whereby the force of spring levers **54** return release plates to their normal resting position.

In an alternate embodiment, shown in figure 8, only one binding **32**, is present. Otherwise, the construction and operation of the pedal is similar to the preferred embodiment having two bindings. This allows easy and simple convertibility to the preferred option by the simple addition of another binding **32**.

A further alternate embodiment of the convertible pedal is shown in figures 11 through 14. A pedal for the left side of the bicycle is shown in all figures. Figure 11A provides a general view of most parts and features. A pedal spindle **112**, preferably formed of high strength steel or titanium alloy, features threads **111** for attachment to a bicycle crank arm (not shown), and wrench flats **113** for tightening to crank arm. Pedal body **114** is preferably formed of aluminum alloy, or other lightweight metal or high strength plastic. All subsequently described parts, unless otherwise noted, are preferably formed of high strength metal such as aluminum, steel, or titanium alloys. Body **114** features central bore **186** (fig. 14), two left side arms **117L**, two right side arms **117R**, and four bail pivot pin bores **137"**. Central bore **186** is machined with threads and multiple steps (not labeled).

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Spindle 112 is rotatably connected to central bore 186 by sealed roller bearing 116, and ball bearing assembly 118 (fig. 14). Sealed roller bearing 116 is a needle type roller bearing that is fixedly mounted in central bore 186 and rotates on journal 119. Roller bearing 116 features integral shaft seals (not labeled) on both sides of the cylindrical rolling elements. Ball bearing assembly 118 comprises two angular contact outer ball races 120A and 120B, that are filled with balls 121, which ride in groove 122 of pedal spindle 112. Retainer cap 124 features hex wrench socket 125, and threads into central bore 186, to tighten against and fixedly retain outer ball races 120A and 120B. Retainer cap 124 features pivot journal 150 (figs. 11A, 11B, 12A, 12B, 14), which is concentric with central bore 186. Pivot tube 152 (fig. 14) is fixedly mounted in central bore 186 and features pivot journal 154 which is also concentric with central bore 186. A small radial clearance is present between pivot tube 152 and spindle 112 such that no rubbing contact occurs.

Two bindings 132 (fig. 12D) are present, one on the upward, shoe facing side of the pedal, and one on the downward, ground facing side of the pedal. Each binding 132 is an assembly comprising base 134, bail 135, bail pivot pin 138, left and right bail springs 139L (fig. 13A) and 139R respectively, block 140, and adjustment screw 141. Base 134 is fixedly mounted to body 114 with screws 195. Slot recess 130 (fig. 11A) locates base 134 onto body 114. Bail pivot pins 138 are fixedly mounted in bail pivot pin bores 137' of left and right side arms 117L and 117R and rotatably support bails 135 on bail pivot pin bores 137' of bail pivot tabs 136L and 136R. Left and right bail springs 139L and 139R are also rotatably supported on bail pivot pins 138. Each bail 135 is urged forwards against base 134 by bail springs 136L and 136R. Urging force of each pair of bail springs 136L and 136R is adjustable by adjustment screw 141, threaded into block 140, and bearing against body 114. Both base 134 and bail 135 feature cleat engaging notches 192. Base 134 features cleat engagement guides 190, and left and right cleat ejector ramps 191 (fig. 11A).

Left front rail connector plate 144L features left pivot bore 145L (figs. 12A, 12B, 13B, 14), limit slot 160 (figs. 12A, 12B, 12C), spring end slot 164 (figs. 11A, 12A, 12B), spring end bore 166 (fig. 12C), retraction lock pin bore 178 (fig. 13A), left semicircular surface 175L, two rail mount tabs 179, each tab featuring two threaded holes 181. Left rear rail connector plate 146L features left pivot bore 147L (figs. 13B, 14), spring end bore 165 (fig. 12C), limit slot 162 (figs. 12A, 12B, 12C), extension lock pin bore 167L (figs. 12B, 12C, 13A, 13B), retraction lock pin bore 177 (figs. 13A, 13B), four threaded holes 185 (figs. 11B, 12B), two rail mount tabs 179, each tab featuring two threaded holes 181 (fig. 11A). Right front rail connector plate 144R features pivot bore 145R (figs. 13B, 14), right semicircular surface 175R (fig. 13A), two rail mount tabs 179, each tab featuring two threaded holes 181. Right rear rail connector plate 146R features right pivot bore 147R, extension lock pin bore 167R, two threaded holes 185, and two rail mount tabs 179, each tab featuring two threaded holes 181 (fig. 13A). Pivot journal 150 rotatably supports left front and rear rail connector plates 144L and 146L on their pivot bores 145L and 147L respectively. Similarly, pivot journal 154 rotatably supports right front and rear rail connector plates 144R and 146R on their pivot bores 145R, and 147R, respectively. Two front rails 142 are fixedly attached to rail mount tabs 179 of left and right front rail connector plates, 144L and 144R with screws 187, to form a front rail cage assembly 148 (figs. 11B, 12B) which pivots as a unit on journals 150 and 154. Similarly, two rear rails 143 are fixedly attached to rail mount tabs 179 of left and right rear rail connector plates, 146L and 146R with screws 187, to form a rear rail cage assembly 149 (figs. 11B, 12B) which also pivots as a unit on journals 150 and 154. Pedal body 114 features limit pin bore 159 (figs. 13A, 13B). Limit pin 158 is fixedly mounted in limit pin bore 159 and protrudes through both limit slot 160 of left front rail connector plate 144L and limit slot 162 of left rear rail connector plate 146L. Front and rear shoe supporting surface sections 115F, 115R, optionally textured as shown here, are formed in the upward, shoe facing edges of both front rails 142, and rear rails 143, respectively, to provide

good shoe sole 28 traction (fig. 12B) when operating in unbound mode. Each pair of front and rear shoe supporting surface sections 115F and 115R, respectively, on each side of the pedal form a shoe supporting surface 115 (fig. 12B), as an assembly, since neither section can support a shoe by itself, due to the freely rotatable body 114. Rail extension spring 156 is rotatably mounted on pivot journal 150, and features ends 157A and 157B (fig. 11A). End 157A is fixedly mounted in spring end bore 165, and end 157B protrudes through spring end slot 164, and is fixedly mounted in spring end bore 166. Rail extension spring 156 urges front rail cage assembly 148 to pivot on journals 150 and 154 clockwise relative to rear rail cage assembly 149, as viewed in figs. 12A, 12B, 13A, and 13B.

Left extension lock pin housing 172L (figs. 11A, 13A, 13B) is fixedly mounted to left rear rail connector plate 146L with housing screws 188 in threaded holes 185. Similarly right extension lock pin housing 172R is fixedly mounted to right rear rail connector plate 146R with housing screws 188 in threaded holes 185. Housings 172L and 172R feature housing lock pin bores 174, which are located coaxially with left and right extension lock pin bores 167L and 167R, respectively. Left and right extension lock pins 168L and 168R are slidably mounted in housing lock pin bores 174, and are urged transversely outwards from the vertical midplane of the pedal by the action of springs 170. Extension lock pins 168L and 168R feature shoulders 169 which limit their outward motion by contact with left and right rear rail connector plates 146L and 146R, respectively. Similarly, retraction lock pin housing 176 is fixedly mounted to left rear rail connector plate 146L with housing screws 188, in threaded holes 185, and features a housing lock pin bore 174 located coaxially with retraction lock pin bore 177. Retraction lock pin 182 is slidably mounted in housing lock pin bore 174 and is urged outward by spring 184 to pass through retraction lock pin bore 177. Shoulder 183 limits outward motion of retraction lock pin 182 by contact with left rear rail connector plate 146L.

In operation, for clipless binding mode, as depicted in figs. 11A, 12A, 12D, 13A, and 14, binding 132 engages and disengages cleat 31 in the same manner as binding 32 in the preferred embodiment, and the description will not be repeated here. In clipless binding operation, front rail cage assembly 148 and rear rail cage assembly 149 are rotated about an axis through the center of pivot journals 150 and 154 to retract shoe supporting surface sections 115F and 115R sufficiently toward the horizontal midplane of the pedal to allow cleat 31 to engage either of the two bindings 132 without contact of sole 28 against the corresponding shoe supporting surface sections 115F and 115R (fig. 12A) on the same side of the pedal. Front rail cage assembly 148 and rear rail cage assembly 149 are held in this retracted position against the force of rail extension spring 156 by retraction lock pin 182 which extends through lock pin bores 177 and 178, thus preventing front rail and rear rail cages from pivoting about the journal axis with respect to each other. Front and rear rail cages 148 and 149, respectively, are simultaneously aligned rotationally with respect to body 114 by contact of limit pin 158 against semicircular end 160' of front rail limit slot 160 and semicircular end 162' of rear rail limit slot 162, respectively. No shoe forces are applied to front rails 142 or rear rails 143, thus only one retraction lock pin 182 is necessary. Cleat 31 can be engaged and disengaged freely from either binding 132 for clipless binding operation without contact of sole 28 on front or rear shoe supporting surfaces 115F and 115R, respectively, or any other part of front or rear rail cage assemblies 148 and 149, respectively. Left and right extension lock pins 168L and 168R are held fully retracted inside extension lock pin housings 172L and 172R, by left and right front rail connector plates 144L and 144R, respectively (fig. 13B).

To set the pedal for unbound operation, as is depicted in figs. 11B, 12B, 12C, and 13B, whereby sole 28 applies full pressure to either shoe supporting surface 115, without contact of recessed cleat 31 on any part of either binding 132 or any other part of the pedal, retraction lock pin 182 is depressed with thumb or finger (not shown) until it exits retraction lock pin bore 178. Rail extension spring 156 then urges front rail cage assembly 148 to pivot on journals 150 and 154 clockwise with

respect to rear rail cage assembly 149, as viewed in fig 12B. This scissors-like action moves both front shoe supporting surface sections 115F, and rear shoe supporting surface sections 115R away from the horizontal midplane of the pedal, extending above bindings 132 on each side of the pedal, and effectively increasing the height of shoe supporting surfaces 115 relative to the height of bindings 132. Once the full outward extension of front rail cage assembly 148 and rear rail cage assembly 149 are reached, they are held in this extended position by left and right extension lock pins 168L and 168R, respectively, which extend outward from the vertical midplane of the pedal, through extension lock pin bores 167L and 167R, respectively, and through the cylindrical surfaces defined by left and right semicircular surfaces 175L and 175R, respectively, thus preventing front rail cage assembly 148 from pivoting counterclockwise with respect to rear rail cage assembly 149 on pivot journals 150 and 154. Front and rear rail cage assemblies 148 and 149, respectively, are simultaneously aligned rotationally with respect to body 114 by contact of limit pin 158 against semicircular end 160" of front rail limit slot 160, and semicircular end 162" of rear rail limit slot 162. In this position shoe forces applied to front and rear shoe supporting surface sections 115F and 115R, respectively, tend to urge, with high force, front rail cage assembly 148 to pivot counterclockwise relative to rear rail cage rail assembly 149, towards the retracted rail position. High shearing forces are generated on extension lock pins 168L and 168R, between extension lock pin bores 167L and 167R, and semicircular surfaces 175L and 175R respectively, and thus two lock pins are used, one on each side of the pedal. This also eliminates twisting forces in front and rear rail cage assemblies 148 and 149 that would be generated if only one extension lock pin 168L or 168R was used. In this configuration, retraction lock pin 182 is held fully retracted inside retraction lock pin housing 176 by left front rail connector plate 144L (fig.13B).

To set the pedal for clipless binding operation, from the unbound, rail cage extended position, front rail cage assembly 148 and rear rail cage assembly 149 are retracted toward the horizontal midplane of the pedal by placing a thumb or finger 98 on front shoe supporting surface section 115F and an opposing finger or thumb 99 the adjacent rear shoe supporting surface section 115R, and squeezing them together, while simultaneously, with the other hand, depressing both extension lock pins 168L and 168R towards each other, into their respective housings 172L and 172R, with the tip of a thumb or finger 98 (fig. 12B) and the tip of an opposing finger or thumb 99 (not shown), respectively. Once left and right extension lock pins 168L and 168R are fully depressed into left and right extension lock pin bores 167L and 167R, respectively, front rail cage assembly 148 can be pivoted counterclockwise with respect to rear rail cage assembly 149 until the fully retracted rail position is reached and locked, as described earlier.

Thusly, body 114, bearings 116 and 118, pivot journals 150 and 154, extension lock pins 168L, 168R, retraction lock pin 182, front rail cage assembly 148, and rear rail cage assembly 149 comprise the primary parts of a rider actuated linkage 110 (fig. 11A) rotatably connecting both bindings 132 and shoe supporting surfaces 115 to pedal spindle 112 in a variable relative height configuration, sufficiently variable to allow the pedal to be used either as a clipless pedal on both sides of the pedal or as a unbound type pedal on both sides of the pedal, where the shoe is not attached to the pedal, and recessed cleat 31 does not contact any part of the pedal.

## CONCLUSIONS, RAMIFICATIONS, AND SCOPE

In conclusion, the invention provides a bicycle pedal that can be operated in either clipless binding mode on both sides of the pedal simultaneously or in unbound mode on both sides of the pedal simultaneously. It eliminates the need to carry separate shoe supporting surfaces that can be attached to a clipless binding pedal. The invention is an improvement over existing dual mode

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pedals, that have one side operating in unbound mode and the other side operating in clipless binding mode, by eliminating the necessity to spin the pedal one half turn, after determining which side is upwardly facing the shoe sole, in order to choose between clipless binding mode and unbound mode operation. This results in safer and more enjoyable riding, and provides a time advantage in some types of racing.

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The description above is detailed and specific, showing only several embodiments out of many possible ones which provide the same novel functionality. As such, the invention is not limited to the description in scope. For example, new materials or fabrication methods may be substituted for the suggested ones in the description, and parts may be changed in size and shape to reduce weight, and costs, to increase strength and durability, or to improve performance, especially in adverse conditions such as the presence of mud or dirt. For instance, in the preferred embodiment, shoe supporting surfaces **15** could be placed slightly higher (further apart from each other) and links **42** made slightly longer to retract bindings **32** further into pedal body **14**. This might provide better shoe sole grip for worn down shoe soles. It could allow the use of certain non-sole recessed cleat and binding systems by allowing the cleat to protrude into cutout **30**. There are other possible mechanism configurations which provide similar functionality. As an example, it is possible to modify the alternate embodiment by affixing bases **134** to rear rail connector plates **146L** and **146R**, and affixing bail pivot pins **138** to front rail side plates **144L** and **144R**, in order to provide height variability in both the binding and the shoe supporting surfaces. This slightly reduces the total height of the pedal when operating in unbound mode. It would also be possible, and obvious to combine the main features of both the preferred embodiment with those of the last alternative embodiment, including the automatic conversion to unbound mode upon cleat release from the binding. There are other existing bindings possible which can be substituted, some of which are simple enough to be formed contiguous with a connecting linkage. Other possible bindings exist which can be substituted that have no moving parts. Other bindings which engage a non-sole recessed cleat may also be used to advantage, as the cleat could protrude slightly into cutout **30**. The shoe supporting surfaces **15** of the preferred embodiment may be shaped differently than shown, such as flat, rather than curved. They may have less surface area shown, to provide extra clearance for muddy conditions. The shoe supporting surfaces of the preferred embodiment may consist of traditional cages, similar to the last alternative embodiment, rather than broad surfaces, though this might limit its compatibility to certain types of shoe sole designs. The need to seal, or otherwise protect the moving mechanisms against dirt and water is obvious and the addition of features not described here can be anticipated, such as shaft seals for exposed rotating parts, flexible boots for exposed sliding parts, gaskets, surface hardening treatments, the addition of rolling elements to replace sliding surfaces or elements, dry-film surface lubrication treatments, surface corrosion protection treatments, surface texturing treatments, or features to provide better shoe grip, etc. The second alternative embodiment described here, having only one binding, but retaining some of the parts necessary for operation with two bindings can obviously be simplified for cost savings, at the expense of being easily convertible to the preferred embodiment, by the simple addition of another binding. Similarly, the last alternative embodiment can be reconfigured to provide for lighter weight, lower cost, and to provide other improvements.

Thus, the scope of the invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.

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